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ADA, OHIO

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This Bulletin contains information concerning the

COLLEGE OF ENGINEERING

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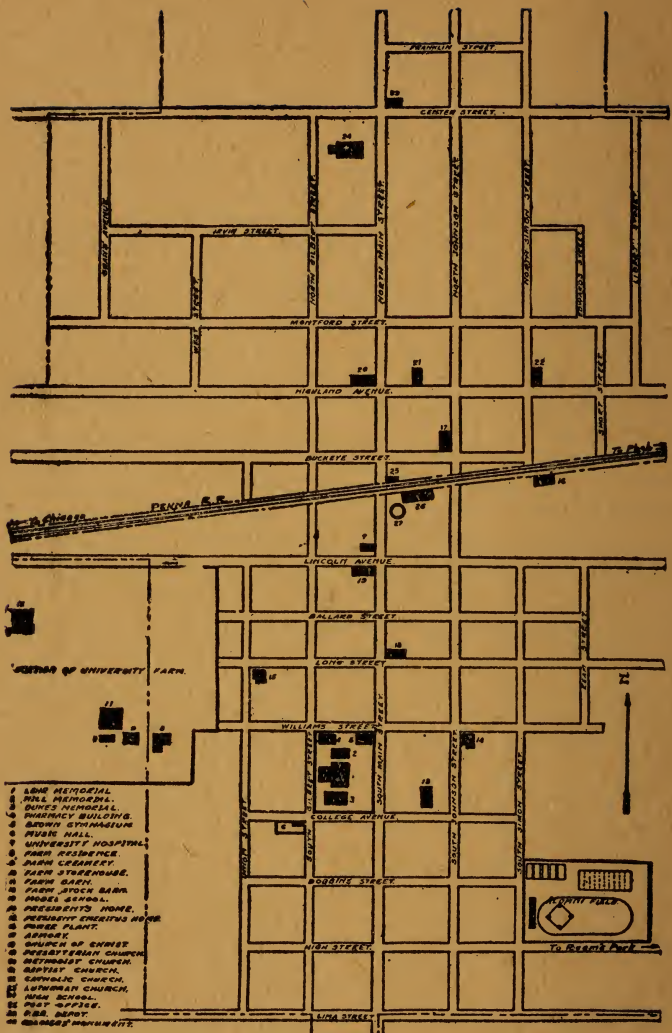
CALENDAR

Fall Quarter____Sept. 11, 1922
Winter Quarter__Dec. 4, 1922
Spring Quarter___Mar. 5, 1923
Summer Quarter_May 28, 1923



ADA AND THE O. N. U.

ADMINISTRATIVE OFFICERS

ALBERT EDWIN SMITH, D. D., Ph. D.,
President

JOHN DAVISON, M. S., Ped. D.,
Vice President

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Executive Secretary

MARGARET E. WHITWORTH, B. S.,
Registrar

COLLEGE OF ENGINEERNG FACULTY

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Dean
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CLARENCE CLEVELAND CARPENTER, C. E.,
Civil Engineering

GUY HERBERT ELBIN, C. E.,
Civil Engineering

IVOR ST. CLAIR CAMPBELL, M. E., E. E.,
Mechanical Engineering

LENIX CRAIG SLEESMAN, Ph. G., Ph. C.,
Chemical Engineering

JESSE RAYMOND HARROD, B. S.,
General Inorganic Chemistry

WHITMAN S. BECKWITH, A. M.,
Higher Mathematics

JOHN THEODORE FAIRCHILD, A. M., C. E.,
Mathematics

FRANK LEWIS BERGER, A. B., B. S.,
Physics

MARTELLE ELLIOTT DAVIS, A. B., Ph. D.,
Modern Languages

CHILDE HAROLD FREEMAN, B. S.,
English

WILFORD E. BINKLEY, A. B.,
Economics

ELLAHUE ANSILE HARPER, A. M., LL. B.,
Contracts

WM. H. SCHAUM,
Assistant in Mathematics

C. M. CARHART
Assistant in Drawing

E. V. JOHNS
Assistant in Mechanical Laboratory

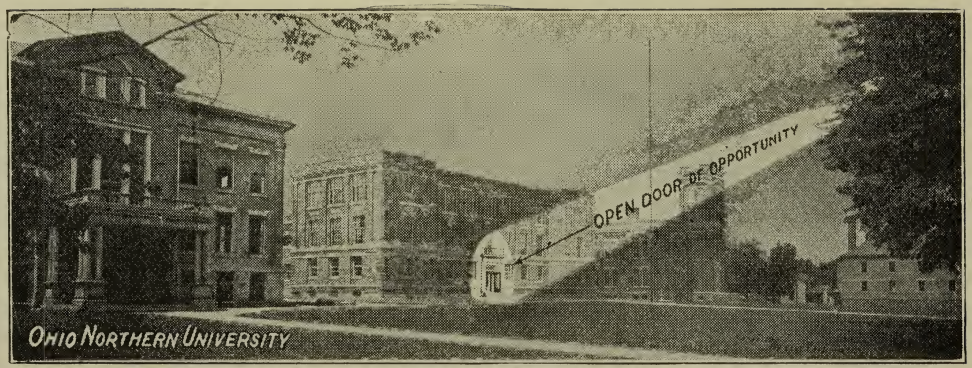
HARRY S. DRURY
Assistant in Machine Shop

EVERETT L. BIRD,
Assistant in Electrical Laboratory

IRVING DIEMER,
Instructor in Armature Winding and Motor Repairing

ARCHIE G. HAIR
Assistant in Chemical Laboratory

CHARLES E. HOEL
Assistant in Physical Laboratory



THE OHIO NORTHERN UNIVERSITY HAS FINE, NEW, UP-TO-DATE BUILDINGS:

The Dukes Memorial with commodious class rooms, offices, and laboratories, devoted to engineering, science, mathematics, and agriculture.

The Lehr Memorial in which is located the executive offices, the Y. M. and Y. W. C. A. rooms, the Library with reading and research rooms, the apartments of the School of Commerce, College of Law, and a magnificent auditorium seating 1500 people.

The Hill Memorial contains ten recitation rooms, two literary societies, electrical and mechanical laboratories, and the central heating and lighting plant. In this building is the department of language, history, philosophy, and College of Education.

The Music Hall has assembly room, studios, offices and many private practice rooms.

The Pharmacy Building, with large laboratories, recitation rooms and Adelphian Literary society.

The Brown Memorial, fitted up for a gymnasium and equipped in first-class shape for indoor athletics. A large modernly equipped Cafeteria together with a Domestic Science Department is connected with this building.

The Horticultural Conservatory, for the propagation and development of plants and flowers.

Ohio Northern University
College of Engineering

THE College of Engineering of Ohio Northern University occupies a unique place among educational institutions; because it is preeminently for the student of moderate means. The chief aim of this college is to place within reach of every ambitious young man a technical college training. With this end in view the school year has been divided into four quarters of twelve weeks each. (Ohio Northern enjoys the distinction of being the pioneer institution to adopt the "quarter plan" which is becoming exceedingly popular among the educational institutions of America). Courses are arranged to meet the needs of students entering at the beginning of any quarter; and the work in our preparatory school has been so arranged that students who are not high school graduates can do their preparatory work here in a minimum of time. Many of our graduates are men of mature years who have done both their preparatory and collegiate work in this institution, at a great saving of time and money. In every community may be found young men (and women also) who have not had opportunity to attend high school. Many of these have, through habits of thrift and industry, accumulated some money. They would gladly enter an engineering school but find themselves unable to meet the entrance requirements of most institutions. To this class Ohio Northern University offers an unusual opportunity. Such men, because of more mature years and industrious habits, may meet the entrance requirements in about two years in our preparatory school. Furthermore, the preparatory work is designed to best meet the requirements of an engineering course.

Note: Those who are not candidates for a degree see "Admission" on page 6.

Ohio Northern University is very cosmopolitan. It gets students from every state in the union and from many foreign countries. In the "Universal Club," an organization of foreign students, twenty-four countries are now (1922) represented.

The method of instruction is by class room work, drafting room, field, and laboratory practice.

Besides the regular course of instruction, one week in the latter part of the winter quarter, known as "Engineer's Week," is devoted to a series of lectures by prominent practicing engineers and manufacturers. This feature, we believe, originated in this institution and has since been adopted by many engineering colleges.

Our engineering students are strongly advised to devote their vacations to surveying, drafting, work in factories, repair shops, electric light and railway stations, and similar work, in order to obtain commercial experience and a better appreciation of the relation of technical training to practical work.

EXPENSES

On account of the large number of students attending Ohio Northern, the cost of living has been reduced to a minimum. Tuition is $34.00 per quarter (12 weeks) or $100.00 per year (36 weeks.)

In order to insure good wholesome food and plenty of it at the least possible cost to the student, the University has recently installed a large, **well equipped Cafeteria** in the Brown Building. This is very much more than "an eating place." With beautiful furnishings and home comforts, this is truly a happy campus "Community center." This is open to the public.

Good board in private homes, $3.50 to $4.25 per week.

Meal tickets at restaurants, $4.00 to $5.00 per week.

Dormitories the "bugbear" of students in some institutions are unknown here. Ada is strictly a school town. The citizens throw open their homes to the students. They have long been noted for their hospitality. Since a majority of the families are engaged in rooming students, the competition is sharp and prices are low. Rooms vary from $1.50 to $2.50 per week according to location and appointments.

All fees such as Matriculation, Registration, Library, Student Activity, etc., are included in tuition charges except a small maintenance fee in Laboratory and Field Work.

TIME REQUIRED

The object of the founders of the College of Engineering of the Ohio Northern University was to provide a school which would be able to furnish an engineering education with the least possible expenditure of time and money. In solving this problem it was deemed wise to offer courses which cover the fundamentals of engineering. and to omit subjects which do not have a direct bearing on engineering. By doing this it has been found possible for a student to do

the required amount of work in ten quarters of twelve weeks each. Because we have thus shortened the engineering course quite materially, some technical schools have seen fit to censure Ohio Northern University. They claim that a thorough knowledge of engineering can not be acquired in so short a time. We agree with them, but we also claim that a thorough knowledge of engineering can not be acquired in a four year course. Years of practice and study after graduation are required to develop one into an efficient engineer. However, in answer to their criticisms **we merely ask that you compare the number of study hours in engineering subjects as shown in this bulletin with the hours in engineering subjects as shown in the bulletins of colleges that require four school years.**

We do not want to be understood as finding fault with these longer courses, which in addition to a thorough scientific training carry with them the benefits of classical culture; and to accommodate those who may thus wish to broaden their education, the excellent instruction of the Classical and Literary departments of the University are **thrown open to all engineering students, free of extra tuition.** A maximum of nine (9) **credit hours** will be allowed for advanced English or other modern languages.

TIME TO ENTER

Students may enter at the beginning of a quarter. Most of the basic engineering subjects are taught at least twice a year; therefore, a student may enter at the beginning of almost any quarter and get the subjects he needs. For schedule of courses see pages 30 and 31.

ADMISSION

Applicants for admission are not required to take entrance examinations. Candidates for an engineering degree must meet all the requirements of a first grade high school before being admitted to the College of Engineering. Distribution of the fifteen units must be as follows:

English	3
Mathematics including solid geometry	3
Physics	1
Electives	6

Two units to be chosen from the following list:

English
Mathematics
Science
Language
History

Those **not aspiring to a degree** may be admitted without having met the requirements, if on consultation, the dean is satisfied that they have sufficient preparation to pursue the work successfully. Such applicants are classified as **special students.** Upon completion of their work, a certificate, showing the course of study pursued and the amount of work covered, will be presented them. However, should a special student desire to become a candidate for a degree he may do so by meeting the entrance requirements. He may, with the consent of the dean, be allowed collegiate credit for work done in first year engineering subjects.

No student will be permitted to take up any subject until he has satisfactorily passed the prerequisites to that subject.

The official form for "Certificate of Entrance," which may be had on application to the Entrance Examiner, should be used in all cases, in order to insure the presentation of necessary information.

ADMISSION WITH ADVANCED STANDING

A liberal policy is pursued in allowing credit for work done in other colleges. Some credit may be allowed for practical experience in drafting, surveying, and shop work. Applicants for such credit must submit a satisfactory statement from their employer, giving time of service, nature of work, name and address of employer.

DEGREES

The University is empowered to grant the customary scholastic degrees, which in the College of Engineering, are Bachelor of Science in Civil Engineering, (B. S. in C. E.); Bachelor of Science in Mechanical Engineering, (B. S. in M. E.); Bachelor of Science in Electrical Engineering, (B. S. in E. E.); and Bachelor of Science in Chemical Engineering, (B. S. in Chem. E.). Two years after graduation, upon presentation of creditable record and approved thesis the regulation degree will be conferred. The College accepts grades of equal value from other institutions of learning, but an applicant for a degree must do at least one year's work here.

One hundred and eighty (180) credit hours are required for graduation.

Two hours field or laboratory work constitute one credit hour.

Every candidate for a degree must prepare a thesis upon some technical subjct, which lies within the field of the degree sought. A thesis may consist of designing, testing, construction, research or a detailed description of some engineering project prepared wholly by the student. The subject must meet the approval of the Professor-in-

charge. The form of the finished thesis to be in accordance with the department and the library.

The subject of the thesis must be announced at least twenty-four weeks before graduation, and the completed thesis must be submitted at least four weeks before graduation.

The granting of degrees is in the hands of the graduation committee of which the registrar is chairman. Recommendation to this committee may be made by the faculties of the separate colleges. The eligibility of each candidate receives individual consideration.

A student cannot be a candidate for more than one professional degree at any one time.

GOVERNMENT

Each student is placed upon his honor. While students are assisted in forming correct habits, this it not a reform school. The opportunity and advantages of the University are offered to all who earnestly desire to develop the best in them and fit themselves for usefulness. All are treated as ladies and gentlemen until they prove themselves otherwise. Regular attendance in classes and thoroughness of work are required.

All students will be received and dismissed at the discretion of the President and Administrative Committee.

GENERAL INFORMATION

1. Students will be accorded certain privileges in the choice of electives as outlined on pages 13-14.

2. Final examinations are held on Wednesday and Thursday of the twelfth week of each quarter. Mid-term examinations are held during the sixth week of each quarter. Written reviews may be given at any time during the quarter.

3. Special examinations for students debarred or deficient at regular examinations are held on the last Tuesday of each term. Where a successful examination would raise the number of Quarter hours above the maximum allowed, said examination will not be permissible. A fee of $2.50 is exacted for each special examination.

4. The following method of grading is in effect: Ex. (Excellent), G. (Good), Av. (Average), P. (Pass), Cn. (Condition), F. (Fail).

Av. denotes that degree of proficiency which should be expected of an average student by carrying eighteen hours.

G. May be made by the average student by placing special emphasis upon the subject studied.

Ex. Indicates that the student has shown extraordinary ability and has acquired a mastery of the subject not to be expected of an average student.

P. is a passing grade and indicates either lack of ability or lack of interest in the subject.

Cn. does not necessarily mean poor work, but may indicate failure to comply with all the requirements of the course. A mark of Cn. may be removed by taking a special examination or by complying with certain other requests of the Professor-in-charge. Thus a Cn. may be replaced by any other mark in the system of grading, but the negative points obtained by the Cn. will continue to count against the student's record. The replacing mark carries no points.

F. denotes failure to pass the course. This mark can not be removed and the student will be required to take the course over with a regular class.

5. The "Point" System is universal throughout the institution.

One hundred and eighty (180) credit hours are required for graduation.

Also, one hundred and eighty (180) points are required for graduation. The following table shows the value of the different marks in terms of credit hours and points for each credit hour of the course:

	Ex.	C.	Av.	P.	Cn.	F.
Credit hours	1	1	1	1	0	0
Points	3	2	1	0	—1	—2

6. Attendance. Each student is required to attend every session of the classes in which he is registered. All absences shall be reported to the instructor upon a regular form furnished by the registrar. This report shall give date, class and reason for absence and must be submitted to the instructor immediately after the occurrence of the absence.

Failure to secure and execute this form will automatically debar the student from consideration by the committee.

Final action on this report will be taken by the "Attendance Committee" of which the registrar shall be chairman. The committee may or may not grant an excuse for such absence. Unexcused absences reduce the College credits one fifth (1-5) of an hour for each absence.

Unexcused absences during the two days preceding or the two days following a holiday will count double.

The "Attendance Committee" or the instructor is empowered to exclude from a course any student whom they may consider to have

been absent so often as to seriously impair his class standing. Any student so excluded will be given a mark of F.

7. Before entering upon any study the student must have passed all the prerequisites to that subject.

8. The Dean may require a student to drop a part of his work at any time, if in his opinion the student is undertaking too much.

9. In case a student desires to **drop or change a course,** it must be done **within seven days after registration** in any quarter, and with the consent of his Dean and professors concerned.

10. No credit will be allowed a student for work in any course unless the election of the work is formally entered on his classification card before the work is begun.

11. After matriculation a student can not without permission of the Dean be admitted to examination in any of the courses given until he has received in the University the regular instruction in such course.

12. Fifteen hours per week is the minimum permitted, while eighteen is the maximum permitted. **Exception,** should the student's record for the preceding term show marks of G. or better in at least three fourths of his work, the faculty may grant permission to carry twenty hours.

13. A mark of F. will be given on any subject dropped without the permission of the Professor in charge and the Dean.

14. Chapel attendance is compulsory.

STUDENTS' TECHNICAL ORGANIZATIONS

The Ohio Northern Chapter of the American Association of Engineers holds bi-monthly meetings. All engineering students are eligible to membership. Proceedings of the American Association of Engineers are received and discussed.

The O. N. U. Society of Chemical Engineers holds meetings every two weeks. Technical papers pertaining to chemical engineering are read and chemical and metallurgical subjects are discussed. All students of chemical engineering are eligible to membership.

The Ohio Northern Branch of the American Institute of Electrical Engineers holds bi-monthly meetings. At these meetings original papers and papers printed in the Proceedings of American Institute of Electrical Engineers are read and discussed. All students interested in electrical engineering are eligible to membership.

The Ohio Northern Society of Mechanical Engineers has been organized for the benefit of those enrolled in mechanical engineering. Its meetings are held bi-monthly; at these meetings original papers

relative to mechanical engineering and its various phases of work together with new developments in the field of mechanical engineering are investigated and discussed by the members of this Society.

In honor of George Washington, "Surveyor, Soldier, Statesman," the above societies devote the week of February 22 to a series of Technical Lectures, Annual Exhibit, Annual Banquet, etc.

Among the visiting lecturers of the past year were: Wm. T. Burns, Timken Roller Bearing Co., Canton, O.; Mr. E. M. Symmes, Chemical Dept., Hercules Powder Co., Wilmington, Delaware; Prof. H. M. Gano, University of Cincinnati, Cincinnati, O.; C. A. Bingham, City Manager, Lima, Ohio; Col. Boyden, Portland Cement Association, Pittsburgh, Pa.; P. O. Tylee, Westinghouse Electric Co., Pittsburgh, Pa; W. H. Adams, Consulting Engineer, Detroit, Mich.

HATCHET ANNIVERSARY

FINANCIAL AID TO STUDENTS

The Board of Education of the M. E. Church lends money to its members who are taking a course in school and have been in attendance long enough to merit a recommendation from the faculty. No interest is charged for two years from date of graduation, and no security is required further than a recommendation from a quarterly conference and from the faculty. Many of our students avail themselves of this advantage.

For further information, address Prof. H. Whitworth, Ada, Ohio, who has charge of this fund.

There is also an Employment Bureau conducted by the Y. M. C. A., whereby many of our students make their entire expenses working as waiters, janitors, and at other occupations in town, being able at the same time to carry on their studies. There is no reason why any ambitious and capable young man or woman desiring an education, should not obtain it at the Ohio Northern University.

Also, many engineering students obtain their education by attending school during the winter and spring quarters and finding employment on engineering projects during the remainder of the year.

CIVIL ENGINEERING

This is the parent stem of all engineering pursuits, and in its broader sense includes all branches of engineering. Many of its former departments have grown into separate professions, yet there still remains a broad and important field, offering greater opportunities than ever before. No sharp line of distinction can be drawn between the provinces of the civil, electrical, and mechanical engineers. This is evidenced by the large number of subjects studied in common by all the students of the various engineering departments: the basic engineering sciences, mathematics, physics, chemistry and some applied sciences being required in all the departments.

A careful study of the schedule and of the descriptions of courses will give the prospective student a good idea of the broad field covered by our courses in civil engineering.

The subjects given in the department of civil engineering are divided into five groups. **Every candidate for B. S. in C. E. degree must take all the subjects in Group 1.** No substitutions will be permitted. The candidate may then select any one of the remaining four groups in which to complete his work. It will be noticed that in each of the remaining four groups appears an item 'elective.' The student may choose these from any of the groups, or from one of the other engineering departments, or with the consent of the Dean, from one or more of the other colleges of the University.

From the foregoing it will be noticed that the student is given much latitude in the choice of his studies. Students are advised to choose electives from such subjects as law, advanced English, and political science; but are not required to do so.

Practically all local improvements are under the direct supervision of the College of Engineering. Many thousands of dollars have been expended the past few years for street paving, macadamizing, sewerage, etc., the major portion of the engineering work being done by the students themselves. A few of the many essential features which we might mention, i, e., establishing street and sidewalk grades, cross-sectioning and computing earthwork, laying out street and alley intersections, installation of sewers and accessories, inspection, specifications, advertisements, proposal and lettings.

EQUIPMENT

For the use of students in the classes in surveying and railroad engineering, the University is fully equipped with transits, levels,

rods, tapes, etc. For classes in stresses and bridge design a large collection of photographs and a number of models of different types of bridges. The testing laboratory contains a Riehle Testing Machine, a Fairbanks Briquette Testing Machine, complete apparatus for cement testing, sets of sieves for analysis of sands and coarse aggregates, a beam testing machine, American Rattler for testing paving bricks, and apparatus for making hydraulic experiments with standard orifices and weirs. Besides, students of civil engineering have access to the laboratories of the Mechanical, Electrical and Chemical Departments.

The drafting room is enlarged and newly equipped with modern apparatus. Individual tables, planimeters, protractors, electric blueprinting machine, and drawing models form part of the equipment of this room.

The following is a schedule of the course offered, showing the number of credit hours per week devoted to each subject:

FIRST QUARTER

Col. Alg. I	5
Trigonometry	5
Mech. Draw. I	4
Chem. I	4
Gym.	1

THIRD QUARTER

Calc. I	4
Mech. Draw III	2
Anal. Geom. II	4
Chem. III	4
Gym.	1
Physics V	4

FIFTH QUARTER

Calc. III	4
Physics VI	5
Field Engr.	5
Hyd. I	5
Gym.	1

SEVENTH QUARTER

M. of M. II	3
Test. Mat.	2
Masonry	3
Options.	10

NINTH QUARTER

Stresses II	4
Br. Des. I	3
Highway Eng.	3
Option	8

SECOND QUARTER

Col. Alg. II	4
Anal. Geom. I	4
Mech. Draw. II	2
Chem. II	4
Physics IV	5
Gym.	1

FOURTH QUARTER

Calc. II	4
Desc. Geom. I	5
Engineering	4
Plane Surv.	5
Gym.	1

SIXTH QUARTER

Mech. of Mtls. I	5
Hyd. II	4
Geol.	3
R. R. I	5
Gym.	1

EIGHTH QUARTER

Stresses II	4
Graphics	5
Reinf. Conc.	3
Contracts	5

TENTH QUARTER

Br. Des. II	3
Foundations	3
Estimates	2
Masonry Des.	3
Option	7

Total Required	157
Group Options	23
	180

Physical Education Credits exclusive of 180 required hours.

CIVIL ENGINEERING GROUPS

REQUIRED

GROUP I

MATHEMATICS

Col. Alg. I, II, III	9
Trigonometry	5
Analytic Geometry I, II	8
Descriptive Geometry I	5
Calculus I, II, III	12

SCIENCE

Chemistry I, II, III	12
Physics IV, V, VI	14
Geology	3
Engineering Problems	4

DRAWING

Mechanical Drawing I, II, II	8

APPLIED

Graphics	5
Stresses I, II	8
Bridge Design I, II	6
Mechanics of Materials I, II	8
Hydraulics I, II	8
Masonry	3
Masonry Design	3
Reinforced Concrete I	3
Foundations	3
Testing Materials	2
Highway Engineering	3
Estimates	2
Law of Contracts	5
Plane Surveying	5
Field Engineering	5
Rail Road I.	5
	157

OPTIONS

GROUP II — **General**

Railroads II	3
Reinforced Concrete II	3
Elementary Electric Machines I	5
Design of Dams	3
Irrigation and Drainage	3
Electives	6
	180

GROUP III — **Sanitary**

Sewerage	3
Reinforced Concrete II	3
Water Supply	4
Chemistry	5
Electives	8
	180

GROUP IV — **Structural**

Descriptive Geometry II	2
Mill Buildings	3
Higher Structures	5
Reinforced Concrete II	3
Metallurgy	2
Electives	8
	180

GROUP V **Mathematical**

Least Squares	2
Geodesy	2
Astronomy	2
Field Astronomy	2
Differential Equations	3
Analytic Mechanics	5
Electives	7
	180

ELECTIVES—Electives may be chosen from the other groups or from the other Engineering Departments or from the Colleges of Law, or Liberal Arts, or Commerce. The electing of such subjects must meet the approval of the Dean.

ELECTRICAL ENGINEERING

The courses offered in this branch of Engineering require a thorough study of theoretical and applied electricity. The first half of the prescribed study is, in the main, the same as that in the Civil and Mechanical Engineering curriculum, including the fundamental engineering sciences, mathematics, drawing and surveying.

The second half consists of courses of study in strength of materials, hydraulics, steam engine, advanced study in the theory of electricity, a large amount of laboratory research and experiment, shop tests, machine drafting and designing, power plant and wiring layouts, and a thorough course in electrical machine design.

The theoretical work is thoroughly supplemented with practical application in the laboratory and in the working out of practical shop projects.

EQUIPMENT

In addition to an excellent Physical Laboratory, the department has a well equipped Electrical Laboratory. An up-to-date engine-driven Electric lighting system has been installed for lighting the University buildings and grounds, and for driving the ventilating motors in the various buildings.

The University power plant comprises two gas engine units. To prevent interruption to the service, storage batteries have been installed. These batteries are available for test and form an important addition to the laboratory equipment.

In the laboratory, both direct and alternating currents may be used for test purposes. The many additions made recently to the laboratory equipment, and the enlargement of the laboratory, have

ELECTRICAL LABORATORY

made it possible to accommodate a large number of students. In addition, the machine shop with its complement of lathes and drill presses and other tools constitutes a valuable acquisition for the department. As a part of the electrical equipment the following may be mentioned: A General Electric three phase generator; a control panel with suitable switches and circuit breakers, meters, etc; a testing panel for the measuring of resistance, or testing of three phase apparatus, a feeder panel for the control of the A. C. and D. C. testing circuits, a five panel switchboard for controlling the main D. C. generators, motor generator sets and storage batteries, equipped with necessary meters, switches, circuit breakers, etc.; a large number of D. C. motors and generators representing the product of seven different manufacturing companies, including an interpole motor of the latest construction; several transformers; Westinghouse, Reliance, Wagner, and Emerson induction motors, both three phase and single phase; induction coils; storage batteries; Electric Tachometer; X-Ray apparatus; frequency meters; galvanometers; bridges, rheostats; watt-hour meters; pronybrakes and about forty voltmeters, ammeters and watt-meters, representing nearly all the best known makes of instruments. In addition to the above, the department has recently acquired a six ring General Electric rotary converter with transformers for three phase operation and a Wagner single phase rotary converter. The department is well supplied with all the necessary

equipment for the conducting of first class laboratory work. The study of Alternating Currents is made very clear by the use of a lecture room oscillograph.

The following is a schedule of the course offered, showing the number of credit hours per week devoted to each subject:

FIRST QUARTER

Col. Alg. I	5
Trigonometry	5
Mech. Draw I	4
Chem. I	4
Gym.	1

THIRD QUARTER

Chem. III	4
Anal. Geom. II	4
Mech. Draw. III	2
Calculus I	4
Physics VI	5
Gym.	1

FIFTH QUARTER

Elec. Machines I	5
Calculus III	4
El. Elec. Machines II	5
El. Elec. Machines Lab. II	4
Gym.	1

SEVENTH QUARTER

Mechanics of Mtls II	3
Elec. Machines. VI	5
Elec. Machines IV	5
Elec. Power Plants	5

NINTH QUARTER

Hydraulics I	4
Differential Equations	3
Elec. Machines IX	5
Steam Turbines	4
Shop Projects	2

OPTIONS

10 hours required

Graphics	5
Elec. Mach IV.	5
Elec. Mach VIII	5

One required

Hyd. Mach'y.	4
Hyd. II	4

SECOND QUARTER

Col. Alg. II	4
Anal. Geom. I	4
Mech. Draw. II	2
Chem. II	4
Physics IV	5
Gym.	1

FOURTH QUARTER

El Elec. Mach. I	4
El. Elec. Mach. I (Lab.)	1
Calculus II	4
Descriptive Geometry	5
Physics V	4
Gym.	1

SIXTH QUARTER

Elec. Machines II	5
Mechanics of Mat'ls. I	5
Elec. Machines V	5
Mechanism	4
Gym.	1

EIGHTH QUARTER

Elec. Machines VII	5
Elec. Machines III	4
Machine Design I	4
Thermo dynamics	5

TENTH QUARTER

Advanced A. C.	5
Hydraulic Machinery or Hydraulics II	4
Elec. Machines VIII	4
Electives	4
Seminar	1

Electives

Telephone Engineering	4
Electric Power Plants	4
Electric Railways	4
Electric Meters	4
Steam Power Plants	4
Power Plant Operation	4
Steam Boilers	3
Gas Engines	5
Plane Surveying	5
Other Colleges	9

Physical Education Credits exclusive of 180 required hours.

MECHANICAL ENGINEERING

Mechanical Engineering deals with the transformation and transmission of energy, and with the theory, design, and construction of mechanism and machinery. The courses offered are selected with a view to the theoretical and practical training that will enable the student to cope with the intricate and complicated problems arising in this important phase of engineering. The first half of the curric-

ulum consists of the basic engineering studies. In the latter half an exhaustive study is made of all phases of heat engineering, together with the design, erection, and maintenance of power plant apparatus.

Thorough training is given in machine drafting, machine design, thermodynamics, steam engines, heating and ventilating, steam boilers, refrigeration, gas engines, electrical machinery, and steam power plants.

EQUIPMENT

The University has its own gas engine-driven lighting plant and a central steam heating plant, lighting and heating all the University buildings. This equipment is installed with special conveniences for making tests on boilers, heating apparatus and power apparatus. In addition the central heating plant of the Ada Heating and Light Co., with its equipment of Corliss engines, high pressure cold and hot water pumps, et cetera, is open to the students for inspection and test.

MECHANICAL LABORATORY

A well equipped machine shop has been added recently to the laboratory equipment, thus giving the student excellent training in the use of tools and general machine shop practice.

The University, because of increasing power demands, contemplates building in the near future a modern power plant equipped with oil and gas engines of the latest types, with a view to making

it a part of the mechanical laboratory, in which tests for efficiency and fuel consumption may be easily and quickly made. The work of installing will be done largely by student help, who thus will get practical experience in moving and erecting engines, switch boards, storage batteries, et cetera. Since the plant will be operated by student help, additional practical experience will be gained.

The following is a schedule of the course offered, showing the number of credit hours per week devoted to each subject:

FIRST QUARTER		SECOND QUARTER	
College Algebra I	5	College Algebra II	4
Trigonometry	5	Anal. Geometry I	4
Mech. Drawing I	4	Mech. Drawing II	2
Chemistry I	4	Chemistry II	4
Gym.	1	Physics IV	5
		Gym.	1
THIRD QUARTER		**FOURTH QUARTER**	
Anal. Geometry II	4	Calculus II	4
Calculus I	4	Desc. Geometry I	5
Mech. Drawing III	2	Physics V	4
Chemistry III	4	El. Elec. Mach. I	4
Physics VI	5	Gym.	1
Gym.	1		
FIFTH QUARTER		**SIXTH QUARTER**	
Calculus III	4	Anal. Mech.	5
Hydraulics I	4	Steam Power Plants I.	4
Thermodynamics	5	Mech. Matls. I	5
El. Elec. Mach. II	5	Mechanism	4
Gym.	1	Gym.	1
SEVENTH QUARTER		**EIGHTH QUARTER**	
Mech. Matls II	3	Stresses I	4
Steam Power Plants II	3	Gas and Oil Engines	3
Plane Surveying	5	Mach. Design I	4
Graphics	5	Machine Shop	3
Valve Gears	2	Metallurgy	4
NINTH QUARTER		**TENTH QUARTER**	
Steam Turbines	4	*Hydraulic Mchy.	4
Heat & Vent. & Ref.	5	Gas Engine Des.	4
Mach. Design II	4	Mech. Laboratory II.	3
Testing Matls	2	Elective	6
Mech. Laboratory I	3		

*Hydraulics II may be substituted for Hydraulic Machy.

OPTIONS—Mill Building (3) and Foundations (3) may be substituted for either Gas or Steam Engine Design in the TENTH QUARTER.

Physical Education Credits exclusive of 180 required hours.

CHEMICAL ENGINEERING

In answer to the growing demand for a course of study that will prepare the student to attack and solve the many chemical and metallurgical problems evolving from the rapid development of the industries, a course in chemical engineering has been arranged. The aim is to not only thoroughly acquaint the student with the fundamental principles of chemical science, but to afford him a complete drill in analysis and in the preparation of inorganic and organic products.

Although this department is only in its infancy, its growth has been much greater than its founders dared even hope it to be.

EQUIPMENT

The equipment for general laboratory work is composed of a full working outfit of apparatus and locker for each student. Tap water and natural gas make each desk a convenient place to work. Specious laboratories with special arrangement for force filtering and for doing quantitative work. Equipment for special laboratory work includes a Brown furnace and burner with motor attachment, gas apparatus, (Official apparatus, United States Steel Corporation), Complete urinary analysis outfit, milk analysis outfit, balances, desiccators, generators, extractors, burettes, pipettes, Nesslers Cylinders, distilling apparatus, picnometers, thermometers, alcoholmeters, saccharometers, etc. Chemical Engineering is a young and growing department and much new equipment is added each year.

The following is the schedule of the course offered showing the number of credit hours per week devoted to each subject:

FIRST QUARTER	
Col. Algebra I	5
Trig.	5
Mech. Draw. I	4
Chemistry I	4
Gym	1

THIRD QUARTER	
Calculus I	4
Physics VI	5
Mech. Draw. III	2
Analyt. Geom. II	4
Chemistry III	4
Gym	1

FIFTH QUARTER	
Qual. Chem. II	5
Thermo.	5
Hydraulics I	4
El. El. Mach. II	5
Gym	1

SEVENTH QUARTER	
*Mech. of Mat. II	3
Ind. Inorg. Chem.	4
*Plane Surveying	5
*Graphics	5

NINTH QUARTER	
Quan. Chem.	5
Org. Chem. II	5
*El. Mach. II	4
Geology	3

SECOND QUARTER	
Col. Algebra II	4
Analyt. Geom. I	4
Mech. Draw. II	2
Chemistry II	4
Physics IV	5
Gym.	1

FOURTH QUARTER	
Calculus II	4
Physics V	4
Qual. Chemistry I	5
El. El. Mach. I	4
Gym	1

SIXTH QUARTER	
Mech. of Mat. I	5
*Hydraulics II	4
Chem. Stochiometry	4
*Des. Geom. I	5
Gym	1

EIGHTH QUARTER	
*El. Mach. I	5
Org. Chem. I	5
Water Supply	4
Metallurgy	4

TENTH QUARTER	
Mechanism	4
Analyt. Chem.	4
Estimates	2
Ind. Org. Chem.	5
College Rhetoric	3
Thesis	

Twenty-five hours of the subjects marked with an * may be made optional from the following courses:

Gas and Oil Engines	3	Stresses	4
Biology I	3	Calculus III	4
Biology II	3	Anal. Mech.	5
Economics	3	Sewerage	3
Contracts	5	Heat, Vent., Ref.	5
Mechanical Lab.	3	Spanish or German	5

Physical Education Credits exclusive of 180 required hours.

STRUCTURAL DRAFTING

This course is designed to give the students a thorough drill in "Drafting Room" practice. There are many young men who for reasons, financial or otherwise, do not aspire to the longer courses leading to a degree; but who would gladly avail themselves of the opportunity to prepare themselves to enter the busy "Structural Field." For such as these we have arranged this course, and upon completion of same a certificate will be granted, which should prove to be a valuable passport into the modern drafting room. There is no preparation other than the grades necessary to enter this course.

FIRST QUARTER

Algebra I	5
English Composition	5
Mechanical Drawing I	4
Geometry I	5

SECOND QUARTER

Algebra II	5
Geometry II	5
Preparatory Rhetoric I	5
Mechanical Drawing II	2
Physics I	5

THIRD QUARTER

Algebra III	5
Geometry III	5
Mechanical Drawing III	2
Descriptive Geometry I	5
Business English	4

FOURTH QUARTER

Algebra IV	5
Machine Drawing	4
Descriptive Geometry II	2
Graphic Statics	5
Trigonometry	5

DISCRIPTION OF COURSES

MATHEMATICS

Mathematics I. College Algebra. 5 hrs. Topics: Rational Fractions; Binomial Theorem; Evolution; Irrational Functions; Quadratic Equations; Equations in Quadratic Form; Simultaneous Quadratic Equations; Ratio, Proportion and Variation: Arithmetical, Geometrical, and Harmonical Progressions. Prerequisite; College Entrance Units, including one and one-half units High School Algebra. Each Quarter.

Mathematics II. College Algebra, 4 hours. Topic: Imaginary and Complex Numbers; Logarithms; Mathematical Induction; Theory of Equations; Determinents. Prerequisite: 1. Winter, Spring, and Summer Quarters.

Mathematics III Trigonometry, 5 hours. Topics: Definitions; Trigonometric Functions and Equations; Inverse Functions; Solution of Plane Triangles with certain applications. Prerequisite; High School Algebra (1½ units). Plane and Solid Geometry (1½ units). Fall, Winter, and Summer Quarters.

Mathematics IV. Trigonometry, 3 hours. Topics: Complex Numbers: DeMoivre's Theorem: Trigonometric Series: Hyperbolic Functions; Spherical Trigonometry, with applications to Geodesy and Astronomy. Prerequisite: 3. Fall and Summer Quarters.

Mathematics V. Analytic Geometry, 4 hours. Topics: Loci and their Equations; the straight Line; the Circle; Graphs in rectangular and Polar Coordinates; Transformations; Conic Sections. Prerequisite: 1, 3. Winter, Spring, and Summer Quarters.

Mathematics VI. Analytic Geometry, 4 hours. Topics Conic Sections; Tangents; Parametric Equations and Loci; Space Coordinates and Loci; the Plane; Special and Quadric Surfaces; Empirical Equations. Prerequisite: 5. Fall, Spring, and Summer Quarters.

Mathematics VII. Calculus (Differential) 4 hours. Topics: Functional Notation; Total and Partial Differentiation; with certain applications; Successive Differentiation; Differentials; Implicit and Explicit Functions; Convergence and Divergence of Infinite Series; Expansion of Functions; Indeterminate Forms; Maxima and Minima of Functions of one Variable. Prerequisite: 5. Fall, Spring and Summer Quarters.

Mathematics VIII. Calculus (Differential and Integral) 4 hours. Topics: Change of Variable; Maxima and Minima of Functions of two or more Variables; Direction of Curves; Tangents and Normals; Tangent Plane and Normal Line; Direction of Curvature; Curvature and Radius of Curvature; Osculating Circle; Envelopes; Methods of Integration by Type of Integrand; Certain applications of simple Integration. Prerequisite: 6, 7. Fall and Winter Quarters.

Mathematics IX. Calculus (Integral) 4 hours. Topics: Integration by Parts; Reduction Formulae; Integration by Substitution; Integration as a Summation; Certain applications; Successive Integration and the application to Surfaces. Volumes, Moment of Inertia, Center of Gravity, Fluid Pressure, Attraction at a Point; Hyperbolic Functions; Cycloid. Prerequisite: 8. Winter and Spring quarters.

Mathematics X. Astronomy (Descriptive) 3 hours. Topics: Reference Points and Lines; the Constellations; the Earth and its Motion; Time; the Moon; the Solar System; the Planets; Comets and Meteors; the Sun; Stars and Nebulae. (Eight hours observations and notes required). Star Maps. Prerequisite: 4. Fall Quarter.

Mathematics XI. Differential Equations. 3 hours. Topics: Equations of the first Order and the first Degree; Equations of the first Order, but not of the first Degree; Equations of the second Order; Linear Equations with constant Coefficients. Prerequisite: 9. Winter Quarter.

12 **Mathematics, XIII. Theoretical Mechanics, 5 hrs.** Topics Center of Gravity; Moment of Areas and Mass: Moment of Inertia; Ellipse of Inertia; Kinematics of a Point; Kinetics of a Material Particle; Work, Energy, Impulse; the simple Pendulum. Prerequisite: 9. Spring Quarter.

*See College of Liberal Arts bulletin for other courses in Mathematics.

PHYSICS

Physics IV. 5 credit hours. This course consists of class and laboratory work in mechanics. A large number of problems are solved. The texts are Kimball's Physics, and Henderson's Physics Problems. Prerequisites: Preparatory Physics, and Trigonometry. Class, three hours; laboratory, two hours.

Physics V. 4 credit hours. (Sound, Heat and Light.) Prerequisites the same as for course 4. Class, three hours; laboratory, two hours.

Physics VI. 5 credit hours. (Electricity and Magnetism). Prerequisites: Physics 4. Texts are the same as above. Class, three hours; laboratory, two hours.

The laboratory work for the above courses requires at least twelve quantitative experiments for each course. The work is based on the following texts: Millikan and Mill's. The experiments are chosen mainly from Millikan's texts.

GENERAL CHEMISTRY

Chemistry I _____4 hrs
Chemistry II _____4 hrs.
Chemistry III _____ 4 hrs.

Courses I and II of this series consist of a careful study of the fundamental laws of Chemistry, with special emphasis on gases, solution, ionization equilibrium, methods of determining molecular weights and colloids. The principles herein involved are applied to the study of the common non-metallic elements.

Course III consists of a brief study of the physical and chemical properties of the common metallic elements and some of their more important compounds together with elementary work in qualitative analysis.

One hour lecture, two hours quiz and four hours laboratory constitute a weeks work.

All of these courses are offered each quarter.

The text is McPherson and Henderson's "A course in General Chemistry."

CHEMISTRY

Chemistry IV. Qualitative Analysis. (Fall and Spring) 5 Hours. The class work constitute a thorough discussion of the theory of qualitative analysis. The laboratory work consists of experiments and reaction with known reagents.

Prerequisites.—General Chemistry 1, 2, 3. Steiglitz text.

Chemistry V Qualitative Analysis. (Winter and Summer) 5 Hours. A systematic course of analysis is thoroughly worked out. At least twelve individual unknowns are analyzed. Prerequisite.—Chemistry 4. Steiglitz text.

Chemistry VI. General Organic Chemistry. (Fall) 5 Hours.

Chemistry VII. General Organic Chemistry. (Winter) 5 Hours. These two courses constitute a thorough study of the structure and constituents of the carbon compounds; the hydrocarbons and carbohydrates with their many addition and substitution products. Prerequisites.—Same as course (4). Bartley text.

Chemistry VIII. Quantitative Chemistry. (Spring) This work consists of volumetric and gravimetric analysis; the

determination of acidity and alkalinity; the analysis of organic and inorganic salts; sugar, milk, urine, etc. Oxidation, reduction and iodimetry experiments are made. Schimpf text.

Chemistry IX. Analytical Chemistry. (Spring) Credit and hours to be arranged. This course is arranged to meet the requirements of students who are making a more thorough study of some special analytical methods. Work from the following subjects, as well as others, can be arranged; the analysis of coal and coke, steel, ores, clays, cement and limestone, water, boiler scale, slag, etc. Prerequisites.—Qualitative and quantitative analysis. Stillman text.

Chemistry X. Industrial Organic Chemistry. (Spring) 5 Hours. Lecture and class work three hours, laboratory four to six hours. This course is designed to acquaint the student with the application and analytical methods as applied to the industries. Prerequisites.—Courses, (6 and 7) Sadtler text.

Chemistry XI. Industrial Inorganic Chemistry. (Summer) 4 Hours. Four hours a week lecture and discussion. Prerequisite.—Same as chemistry 4.

Chemistry XII. Chemical Problems and Equations. (Spring) 4 Hours.

DRAWING

1. **Freehand Drawing.** Sketches and pencil work.

2. **Mechanical Drawing I.** 4 credit hours. Use of instruments, applied geometry, lettering and orthographic projections. Text: French Engineering Drawing.

3 **Mechanical Drawing II.** 2 credit hours. Developments, intersections, pictorial drawing. Prerequisites: Mechanical Drawing I. Text: French Engineering Drawing.

4. **Mechanical Drawing III.** 2 credit hours. Working drawings. Prerequisites: Mechanical Drawing II. Text: French Engineering Drawing.

5. **Descriptive Geometry I.** 5 credit hours. Advanced orthographic projections. Problems of point, line, plane and curved surfaces. Prerequisites: Mechanical Drawing III. Text Church and Bartlett.

6. **Descriptive Geometry II.** 2 credit hours. Shades, shadows and perspectives. Prerequisites: Descriptive Geometry I. Text: Church and Bartlett.

CIVIL ENGINEERING

1. **Plane Surveying.** 5 credit hours. Use of chain, level and transit. Prerequisites; Trigonometry. Text; Pence and Ketchum Surveying Manual.

2. **Field Engineering.** 5 credit hours. Land surveying, topographic surveying by stadia and transit, city surveying and measurements of volumes. Prerequisites; Plane Surveying. Text: Johnson and Smith.

3. **Railroad Surveying.** 5 credit hours. Simple curves, compound curves, reverse curves, spirals, switches and turnouts. Prerequisites; Field Engineering. Text: Searles and Ives Field Engineering.

4. **Railroad Construction and Maintenance.** 3 credit hours. Organization, rules, ballast, ties, rails, track design, trestles, culverts, roadway machines, work of the M. of W. department. Prerequisites: Railroad Surveying. Text: Willard, Maintenance of Way and Structures.

5. **Highway Engineering.** 3 credit hours. Design, construction and maintenance of earth roads, paved roads and streets. Prerequisites: Geology and Field Engineering. Text: Baker's Roads and Pavements.

6. **Geology.** 3 credit hours. A study of the earth's crust dealing with rock form and structure, and the formation of mineral deposits, mountain folds and faults. Prerequisites: Chemistry. Text: Chamberlain and Salisbury.

7. Sewerage. 3 credit hours. General course on sewerage systems. Prerequisites: Hydraulics II. Text: Folwell.

8. Irrigation and Drainage. 3 credit hours. History, use of water for irrigation, collecting and distributing works, construction and maintenance. Prerequisite: Hydraulics II. Text: Professor's Notes.

9. Hydraulics I. 4 credit hours. Static water pressure, flotation, buoyancy, laws of falling bodies, applied to hydraulics, measurements of flow. Prerequisites; Physics and Calculus III. Text: Merriman's Treatise on Hydraulics.

10. Hydraulics II. 4 credit hours. Flow of water not under pressure, water supply studies, water power, theory of water motors, naval hydromechanics and theory of pumps. Prerequisites: Hydraulics I. Text: Merriman.

11. Astronomy. See "Mathematics."

12. Field Astronomy. 2 credit hours. Observation and computation. Text: Comstock, Prerequisite: Astronomy.

13. Geodesy. 2 credit hours. Geodetic surveying and map making. Text: Merriman. Prerequisites: Least Squares and Field Astronomy.

14. Masonry. 3 credit hours. Natural stones, building bricks, limes, cements, sand, gravel, broken stone, lime and cement mortars, plain concrete, building blocks and artificial stones, stone and brick masonry, and ordinary foundations. Prerequisites: Mechanics of Materials I. Text: Baker's Masonry Construction.

15. Masonry Design. 3 credit hours. Plain concrete arches, bridge abutments ,and retaining walls. Prerequisites: Masonry. Text: Professor's Notes.

16. Mechanics of Materials I. 5 credit hours. General principles of stresses, elastic limit, shear, riveted joints, torsion, center of gravity, moment of inertia, stresses in beams beams with more than two supports, shears in beams. Prerequisites or concurrents: Calculus III. Text: Boyd's Strength of Materials.

16. Mechanics of Materials II. 3 credit hours. Special beams, bending combined with tension or compression, column theory, column formulas used by engineers, resilence in bending or shear, combined stresses, theory of elastic limit and failure, curved beams and hooks. Prerequisites: Mechanics of Materials I. Text: Boyd.

17. Stresses I. 4 credit hours. Dead load, snow load, wind load and live load stresses in roof trusses. Dead load, live load and wind load stresses in simple bridge trusses. Prerequisites: Mechanics of Materials I. Text: Merriman and Jacoby's Roofs and Bridges Part I.

17. Stresses II. 4 credit hours. Continuation of live and wind load stresses in bridge trusses, theory of least work, deflection of trusses, history and evolution of bridge trusses. Prerequisites: Stresses I. Text: Merriman and Jacoby's Roofs and Bridges Part I.

18. Graphics. 5 credit hours. Graphical method of combining forces, moment and shear in beams, stresses in roof trusses, due to dead, wind and snow loads, stresses in bridge trusses due to dead, wind and uniform live loads. Prerequisites: Mechanics of Materials I. Text: Merriman and Jacoby's Roofs and Bridges Part II.

19. Bridge Design I. 3 credit hours. Design of roof truss and plate girder bridge. Prerequisites: Stresses II. Text: Merriman and Jacoby's Roofs and Bridges Part III.

20. Bridge Design II. 3 credit hours. Design of steel truss bridge. Prerequisites: Stresses II. Text: Merriman and Jacoby's Roofs and Bridges Part III.

21. Higher Structures. 5 credit hours. Continuous, cantilever, draw, and suspension bridges. Three hinged arches, two hinged arches and hingeless arches. History of large bridges. Prerequisites: Bridge Design II. Text: Merriman and Jacoby's Roofs and Bridges Part IV.

22. Mill Buildings. 3 credit hours. Computation of stresses and design of modern buildings. Prerequisites: Stresses II. Text: Ketchum's Mill Buildings.

23. Reinforced Concrete I. 3 credit hours. Design of concrete beams, girders, slabs, columns and footings. Prerequisites: Mechanics of Materials I. Text: Taylor and Thompson.

24. Reinforced Concrete II. 3 credit hours. Design of concrete bridges, chimneys, arches, and retaining walls. Prerequisites: Reinforced Concrete I. Text: Taylor and Thompson.

25. Water Supply. 5 credit hours. Requisites of a water supply, quality of water, collecting and distributing works, studies of rainfall and run off, works for treating water, pumping plants. Prerequisites: Hydraulics I. Text: Folwell.

26. Testing Materials. 2 credit hours. Testing cement mortars, tests of small wooden beams and columns with deflection instrument, tension test of steel and iron with extensometer, tests for impurities in concrete aggregates, sieve analysis of concrete aggregates. Prerequisites: Mechanics of Materials I. Text: Hatt and Scofield's laboratory of Testing Materials.

27. Foundations. 3 credit hours. A descriptive course dealing with pile foundations, pile driving, sheet piling, cofferdams, open and pneumatic caissons, open wells, types of piers and abutments and underpinning. Prerequisites: Masonry. Text: Jacoby and Davis' Foundations of Bridges and Buildings.

28. Design of Dams. 3 credit hours. Gravity masonry dams, arched masonry dams, hollow masonry dams, rock fill dams, rolled earth dams and hydraulic fill dams. Prerequisites: Masonry and Hydraulics I.

29. Estimates. 2 credit hours. Estimating quantities of material and costs of various engineering structures. Prerequisites: Can not be taken before the eight quarter. Text: Professor's Notes.

30. Law of Contracts. 5 credit hours. See Bulletin of Law College. Can not be taken before the sixth quarter.

ELECTRICAL ENGINEERING

1. Elementary Electric Machines I. 4 credit hours. For M. E. and C. E. students, for first year E. E. students. D. C. Generators and Motors, Train Lighting, Storage Batteries. Text: Gray's Principles and Practice of Electrical Engineering. Prerequisites: Plane Trigonometry; Physics VI.

2. Elementary Electric Machines Laboratory I.—one credit hour. A practical laboratory course in the operation of direct current machines paralleling Elementary Electric Machines I. Text: Same as I.

3. Elementary Electric Machines II. 5 credit hours. Continuation of course 1. Alternating current circuits, alternators, transformers, induction motors, transmission, illumination. Text: Gray's Principles and Practice of Electrical Engineering. Prerequisite: Elementary Electric Machinery 1.

4. Elementary Electric Machines Laboratory II. Five credit hours a continuation of course one including the characteristics of direct current machines. Behaviour of circuits containing resistance, inductance and capacity: Operation of alternating current machines, paralleling Elementary Electric Machines II.

Elementary Electric Machines II. Text: Same as I and 2.

5. Electric Machines I. 5 credit hours. (D. C. Generators). Physical theory, construction, magnetization curve, reactions, winding, operating characteristics, Problems. Text: Langsdorf's Principles of Direct Current Machines. Prerequisites: Elem. Elec. Machinery 1., Calculus I, II.

6. Electric Machines II. 5 credit hours. (D. C. Motors) Commutation, reaction, efficiency, rating, heating, problems. Text: Langdorf's Principles of Direct Current Machines. Prerequisites: Electric Machinery I.

7. Electric Machines III. Four credit hours A laboratory course in D. C. dynamo testing Text Professor's notes, library. Prerequisites Elec. Mach I, II.

8. Electric Machines V. Five credit hours. Alternating currents, the solution of circuits containing resistance, inductance and condensance. Power in single and polyphase circuits. Chapters I to X inclusive Texts Magnusson-Alternating Currents, Lyon-Problems in Electrical Engineering. Prerequisites Elec. Mach. 1, II.

9. Electric Machines VI. Five credit hours. Alternating current machines. The transformer, induction motor, alternator, single phase motors. Chapters XI to XVIII inclusive. Texts Magnusson—Alternating Currents. Library assignments. Prerequisites Elec. Mach V.

10. Electric Machines VII. Five credit hours Insulation. The dielectric circuit, Electric Transmission Chapters XIX to XVII inclusive. Texts Magnusson-Alternating Currents. Prerequisites Elec. Mach, V, VI.

11. Electric Machines VIII. Five credit hours. Alternating current machine design. Text Grays-Electrical Machine Design.

12. Electric Machines IX. Four credit hours. A laboratory course in the testing of alternating current machinery.

13. Alternating Currents. Five credit hours. Advanced theory, vector analysis, complex notation. Problems. Texts: Bedell and Crehore's Alternating Currents. Lyon's Problems in Electrical Engineering. Prerequisite: Electric Mach. VI., VII.

14. Shop Projects. Five credit hours required for graduation. Practical projects involving calculation, drafting, engineering judgment and skill in construction or repair work. These projects may vary from armature winding and motor repairing to the design and construction of laboratory apparatus. Shop methods are approached as nearly as possible. The number of projects assigned varies with the difficulty and amount of time required but it is aimed to give each student a considerable breadth of experience. This course involves no class room or text book work and the course is usually covered in one hour per quarter for five quarters. Individual assignments are made to each student.

15. Electric Railways. 4 credit hours. Traffic studies. surveys, probable earnings, construction, heavy main line electrification. Hardings Electric Railway Engineering, Current Periodicals. Prerequisites: For C. E. students: Elementary Electric Machinery I., for E. E. students Electric Machinery VI. and VII.

16. Electric Meters. 4 credit hours. Theory, construction, testing, calibration. Text: Jansky's Electrical Meters. Prerequisites: Elementary Electric Machinery II.

17. Storage Batteries. 4 credit hours. Chemical Theory, construction, boosters. Text: Lyndon's Storage Battery Engineering. Prerequisites: Chemistry II., Electric Machinery II.

18. Telephone Engineering. 4 credit hours. Circuits, apparatus, central office equipment, cable plant, inspection trip,

tests in laboratory. Prerequisites: Physics VI., Elementary Electric Machinery I.

19. Electric Power Plant Engineering. Power plant layouts, switch gear operation. Plant management and economics. Text: Croft—Central Station. Prerequisites: Electric Machinery VI.

MECHANICAL ENGINEERING

1. Thermodynamics.—5 credit hours. Theory of heat, gases, vapors, steam engine cycles, and practical applications of thermodynamics, entropy and entropy diagrams. Text: Moyer-Calderwood-Potter, Elements of Engineering Thermodynamics. Prerequisites: Physics V. and Valculus II.

2. Steam Power Plants I. 4 credit hours. A study of the combustion, handling and storage of fuel, and of steam generating machinery including boilers, stokers, steam engines, steam turbines and condensers. Text: Gebhardt, Steam Power Plant Engineering. Prerequisite: Physics V.

3. Steam Power Plants II. 3 credit hours. A continuation of Steam Power Plants I with consideration given to complete installations, the cost of power, typical specifications and the power test codes.

4. Steam Turbines. 4 credit hours. Nozzle and blade design, mechanical losses, impulse turbines, reaction turbines, impulse-reaction turbines, governing, economics of turbine operation, and the gas turbine. Text: Moyer, Steam Turbines. Prerequisite: Thermodynamics.

5. Gas and Oil Engines. 3 credit hours. Liberation of heat energy, combustion, engines burning gas, kerosene and gasoline, semi-Diesel and Diesel engines, automobile engines, carburetion, ignition and testing. Text: Streeter, Internal Combustion Engines. Prerequisite: Thermodynamics.

6. Valve Gears. 2 credit hours. The Bilgram and Zeuner diagrams, port openings and passage areas, slide valves, corliss valve gears, poppet valves, shaft governing, valve setting, veversing gears. Text: Fessenden, Valve Gears. Prerequisites: Descriptive Geometry I. and Thermodynamics.

7. Metallurgy. 4 credit hours. General metallurgical processes and the metalurgy of the common metals. Text Austin, Metallurgy of the Common Metals. Prerequisites, Chemistry III.

8. Heating, Ventilation and Refrigeration. 5 credit hours. Heating and Ventilation. Heat losses from buildings, methods of heating, boilers, radiators and accessories, steam systems, hot water systems, automatic temperature control, hot air furnace heating, fan systems, air washers and air conditioning. Text: Allen and Walker, Heating and Ventilation. Prerequisites: Thermodynamics.

9. Refrigeration. Cold and its production, commercial systems of refrigeration, comjression systems, ice making systems, installation and operation of a refrigerating system, capacity of refrigerating machines, cold storage duty. Text: Greene, Element of Refrigeration. Prerequisite, Thermodynamics.

10. Hydraulic Machinery. 4 credit hours. Hydraulic Turbines. Types of turbines and setting, water power, tangential water wheels, reaction turbines, governors, testing, selection of type. Text: Daugherty, Hydraulic Turbines. Prerequisites: Calculus II. and Hydraulics I.

Centrifugal Pumps. Description, installation and operation, theory, classification, disk friction, efficiency, testing, costs, application, design. Text: Daugherty Centrifugal Pumps. Prerequisites: Calculus II, Hydraulics I.

10. Mechanism. 4 credit hours. Mechanisms, motion and velocities, kinematic chains, instantaneous centers, velocity diagrams, parallel and straight line motion, cams, gearing, bevel gears, gear trains, belting, intermittent motions. Text: Schwamb, Merrill and James, Elements of Mechanism.

11. Machine Design I. 4 credit hours. Design and drawing of details as proportioned by stress. Energy of machines, riveted joints, shafts, bearings, clutches, belts, brakes, flywheels, gears, springs and frames. Text: Smith and Marx, Machine Design. Prerequisites Mechanism, Mechanics of Materials I. and II.

12. Machine Design II. 4 credit hours. Complete design and detail of machine units. Text: Professor's notes.

13. Gas Engine Design. 4 credit hours. Design of a gas or oil engine. Complete calculations and detail drawings required of each member of the class. Text: Streeter, Internal Combustion Engines. Prerquisits: Gas, and Oi Engines and Machine Design I.

14. Mechanical Laboratory I. 3 credit hours. Use of planimeter, calibration of instruments, approximate coal analysis, heating value of coal by use of bomb calorimeter, study of engine indicators and their use, and determination of steam quaity. Text: Moyer, Steam Power Plant Testing. Prerequisite: Thermodynamics.

15. Mechanical Laboratory II. 3 credit hours. Flue gas analysis, boiler tests, engine indicator and brake horse power tests, indicator card analysis, fan tests, complete power plant tests. Text: Moyer, Steam Power Plant Testing. Prerequisite, Mechanical Laboratory I.

16. Machine Shop. 3 credit hours. Bench work in filing, chipping and fitting. Machine work in threading, turning, boring, drilling, shaping, tool grinding, etc. Text: Smith, Advanced Machine Work.

THE ANNUAL INSPECTION TRIP

The Senior Class as a whole devotes one week to an extended visit to some large commercial center. The odd year class spends every minute profitably in the study of the various phases of engineering and industrial activity in Chicago, Gary, and Fort Wayne. The even year class does the same in Pittsburgh and vicinity.

POSITIONS

Our experience in the past has been that the demand made upon the College of Engineering for graduates has been far in excess of the supply. Many employers insist on us granting concessions whereby our men can get away at the earliest moment to report for duty. The question is asked us sometimes whether we guarantee to secure positions for our graduates. This question we must answer in the negative, as no responsible school can afford to make such a guarantee.

COLLEGE OF ENGINEERING
CLASS OF 1922

Cripps, Glen D._____President

BACHELOR OF SCIENCE IN CIVIL ENGINEERING

Berta, A. H._Duquesne Pl. Pa.
Coene, H. C._New Brighton Pa.
Cuellar, A____La Paz, Bolivia
Carhart, C. M. Pittsfield, Mass.
Detlor, C. C.__Woodsfield. O.
Duff, R. E._____Canton, O.
Demerotto AT Wistbury, LI NY
Dispinza, S. J._Buffalo, N. Y.
Gehr, H. W.__Waynesboro, Pa.
Henning, L. R.____Weston, O.
Horowitz, Theo. _____Ada, O.
Lorini, Hector_LaPaz, Bolivia
Lamb, P. Y. Hongkong, China
Leach, C. H. _____Butler, Pa.
Miller, B. L. ____Trenton, N. Y.
Morgan, D. M. Hazleton, Pa.
Ogan, Ray____Cumberland,. O.
Page, W. _____Urbana, O.
Waterloo, V. E. Sturgeon, Pa.
Cobb, D. F. _____Akron, O.

BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING

Decker, B. L. _____Lilly, Pa.
Kille, L. A. _____Salem, O.
Wells, J. E. _____ Ada, O.

ELECTRICAL ENGINEER

Erdman, E. A.____Augusta, Wis.

BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

Bochiniski, Felix Detroit Mich
Chambers, D. F. __Findlay, O.
Cripps, G. D.__Grayling, Mich.
Castro, Santos_Mayagnez, PR
Cottrell, T. Bradley Bch. N. J.
Leiski, G. ____Oak Harbor, O.
Liano, M. _____Arecibo, P. R.
Levinkowski, F., Smol., Poland
Navidad, J. ____Phil. Islands.
Reynolds, J. E Bridgept. Conn
Steinberg, E. J. ____Phila. Pa.
Thompson, J K,New Brightn Pa
Wentzel, E. G. ____Lima Peru.
Angulo, M. Calamus, Col, S. A.
Rodas, Jos. Las Piedras, P. R.
Hilton, L. S. Springfield, Mass.
Laurens, S. _____ Mexico.

BACHELOR OF SCIENCE IN CHEMICAL ENGINEERING

Cummings, S. H. Rose Hill NY
Haney, H. L. _____ Ada, O.
Jones, Arlie, Ft. Recovery, O.
Savage, P. A. Blanchester, O.
Starner, A. D. _Big Prairie, O.
Zugsda, E. G. __Cleveland, O.

Note:—Subject to correction.

SCHEDULE OF CLASSES

HOUR	PROFESSOR	FALL		WINTER		SPRING		SUMMER	
7:00	ALDEN CARPENTER ELBIN CAMPBELL BERGER FAIRCHILD HARROD	El. El. Mach. I Thermo Coll. Alg. I Chem. I	4 5 5 4	El. Mach. I Thermo Trig I Chem. II	5 5 5 4	El. Mach. II St. Power Plts. I Anal. Geom. I Chem. III	5 4 4 4	El. Mach. VI Irrig. & Drain Graphics St. Turbines Physics VI	5 3 5 4 5
8:30	ALDEN CARPENTER ELBIN CAMPBELL BERGER SLEESMAN HARROD FAIRCHILD	El. Mach. VII Rein. Conc. I Mech. Matls I Metallurgy Physics V Qual. Chem. I Chem. I Anal. Geom. II	5 3 5 4 5 5 4 4	El. El. Mach. II Rein. Conc. II Mech. Matls II St. Turbines Physics VI Qual. Chem. II Chem. II Coll. Alg. II	5 3 3 4 5 5 4 4	Advanced A. C. Testing Matls. Mill Bldg. Mech. Matls I Valve Gears Physics IV. Qual. Chem. I Chem. III Trig. II	5 2 3 5 2 5 5 4 3	Elective Des. of Dams Mech. Matls II Gas & Oil Eng. Qual. Chem II Chem I Anal Geom. I	 3 3 3 5 4 4
9:30	ALDEN CARPENTER ELBIN CAMPBELL BERGER SLEESMAN HARROD BECKWITH FAIRCHILD	El. Mach. V Stresses I Desc. Geom I Mechanism Physics IV Qual. Chem. I Chem. II Astronomy Coll. Alg. I	5 4 5 4 5 4 3 5	 Stresses II Graphics Ht. Vent. & Ref. Eng. Probs. Qual. Chem. II Chem. III Diff. Equations Coll. Alg. II	 4 5 5 4 4 3 4	El. Mach. V Stresses I Masonry Des. Hyd. Mchy. Physics VI Qual. Chem. I Chem. I Anal. Mech. Coll. Alg. I	5 4 3 4 5 4 5 5	El. Power Plts Stresses II Masonry St. Power Plts. II Elective Qual. Chem. II Chem. II Trig. II Coll. Alg. II	5 4 3 3 5 4 3 4

10:30	ALDEN	Telephone Eng. 4	Elec. Mach. VI 5	El. Mach. VIII 5	
	CARPENTER	Hyd. II 4	Hyd. I 4	Hyd. II 4	Hyd. I 4
	ELBIN	Graphics 5		Desc. Geom. I 5	
	CAMPBELL	Gas & Oil. Eng. 3		Gas. Eng. Des. 4	Mach. Des. I 4
	SLEESMAN	Chem. Anal. I 5	Chem. Anal. II 5	Chem. (Stochio.) 4	
	HARROD	Chem. III 4	Chem. I 4	Chem. II 4	Chem. III 4
	BECKWITH	Calc I 4	Calc. II 4	Calc. III 4	Calc. I 4
	BERGER	Eng. Prob. 4	Phy. IV 5	Phy. V. 4	
1:00	ALDEN	El. El. Mach. lab 1 El. Mach. III lab 4	El. M. III, IXa, b El El M II. *(SP) 5		El. Mach. IV 5
	CARPENTER	Br. Des. I 3	Testing Matls 2	Br. Des. II 3	
	SLEESMAN			Organ. Chem. III	Ind. Inorg. Chem. 5
	CAMPBELL	Mach. Des. I 4	Mach. Des. II 4	Mechanism 4	Mach. Des. II 4
	BECKWITH	Calc II 4	Calc III 4	Calc. I 4	(Elective)
	FAIRCHILD		Coll. Alg. I 5	Coll. Alg. II 4	Coll. Alg. I 5
	STAUFFER		Geology 3		
2:00	ALDEN	Same as I o'clock	Same as 1 o'clock		
	CARPENTER	Water Supply 5	Highway Eng. 3	Foundations 3 Estimates 2	Testing Matls. 2
	ELBIN	Plane Survey 5 Cl. T Th-Fld. MWF	Field Eng. 5 Cl MWF-Fld. T Th	R. R. Survey 5 Cl. MWF-Fld. T Th	Plane Survey 5 Cl. T Th-Fld. MWF
	CAMPBELL	Mach. Shop 3	Mech. Lab. I 3	Mech. Lab. II 3	Mach. Shop 3
	SLEESMAN	Org. Chem. I 5	Org. Chem. II 5	Quan. Chem. I Organic Chem. III 5	Elective
	HARROD	Prep. Physics I	Prep. Physics II	Prep. Physics III	
	BECKWITH	Trig. I 5	Anal. Geom. I 4	Anal. Geom. II 4	Anal. Geom II 4
	FAIRCHILD	Trig I 5	Analy. Geom I 4	Anal. Geom. II 4	Trig I 5
	HARPER	Contracts			
3:00	ALDEN	Same as I o'clock	Same as 1 o'clock		
	CARPENTER		Higher struc. 5		
	ELBIN	Same as 2 o'clock	R. R. II 3	Same as 2 o'clock	
	CAMPBELL	Mach. Shop 3	Mech. Lab. I 3	Mech. Lab. II 3	Mach. Shop 3
	SLEESMAN	Organic Chem I	Organic Chem. II	Quantitative I	
		Mech. Dwg. I 4	Mech. Dwg. II 2	Mech. Dwg. III 2	Mech. Dwg. III 2
4:00	ELBIN		Masonry 3		

*Shop Projects

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For Literature Address: THOMAS J. SMULL.
Executive Secretary

UNIVERSITY BULLETIN

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